SeaWiFS Spies Reefs

Comprehensive surveys of the world's oceans are difficult and prohibitively expensive, and as a result, our understanding of the global distribution of coral reefs is limited and often incomplete or even inaccurate. The recent development of ReefBase (by the International Center for Living Aquatic Resources Management -ICLARM and the World Conservation Monitoring Centre - WCMC) provides a comprehensive digital database of reefs for the entire globe. But ReefBase was built, of necessity, from a wide variety and quality of charts and records, and has inherent inaccuracies and limitations. Improved information on depth, bottom type, and area could improve our understanding of reefs. Satellite data can supplement existing data sets by providing repetitive coverage, consistent sampling methods and access to remote and otherwise poorly observed regions of the planet.

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Several types of data exist, including thermal information, low resolution (9-50 km) and medium resolution color imagery (1 km), as well as high resolution imagery from Landsat, SPOT, Space Shuttle and aircraft. Thermal imagery is already used to research and monitor coral bleaching (Strong *et al*. **Reef Encounter 24**, p. 20-21 and Toscano *et al*. this issue). Ocean color imagery measures water constituents like phytoplankton chlorophyll-a, and also detects depth and bottom characteristics, particularly the presence of pigments.

SeaWiFS (Sea-viewing Wide Field-of-View Sensor), launched in September 1997, provides a unique opportunity to obtain global information on shallow water environments. The SeaWiFS sensor is designed for routine global monitoring of the color of the ocean and is a joint effort between NASA and Orbital Imaging, Inc.. Although specializing in chlorophyll measurement, the sensor can also extract depth and bottom characteristics. SeaWiFS

has a field of view as narrow as 1.1 km per pixel, and potential repeat coverage of every two days in the tropics. With onboard storage capabilities and a network of over 65 high resolution receiving stations, SeaWiFS provides information for just about anywhere in the world, which is a critical factor in developing information on coral reef environments in remote tropical areas.

Since the launch, SeaWiFS data has been collected, processed, archived and distributed by NASA to researchers around the world. In collaboration with NOAA, a set of high resolution SeaWiFS imagery covering the regions of the world's oceans where coral reefs are found is being developed into a database of shallow water environments and benthic habitats. This database identifies land, three water depths (deep > 20-30 m, medium 20 m to 5 m, and shallow < 5 m) and areas with high and low chlorophyll. By working with WCMC, we are able to overlay coastlines and their 1 km database of reef locations on the satellite imagery (Figure 1). As new images become available, we update the database. We now have coverage of over 90% of the tropical ocean where reefs occur (between 35S and 35N). The current algorithm has limitations as chronically turbid water cannot be separated from shallow water, and dense bottom vegetation (seagrass or algae) may be classified as deeper than appropriate. These problems are minor in most areas, and will be resolved as we populate the database and tune the algorithm. The task is huge, and the final database image will be over 250 million pixels (36,000 by 7,000). By overlaying the ReefBase map on the SeaWiFS-derived depth classification, we hope to verify the existing map, identify potential reefs that may have not been included in the initial survey, and correct any inaccuracies.

In addition, as imagery from Space Shuttle pho-

SeaWiFS Depth Classification
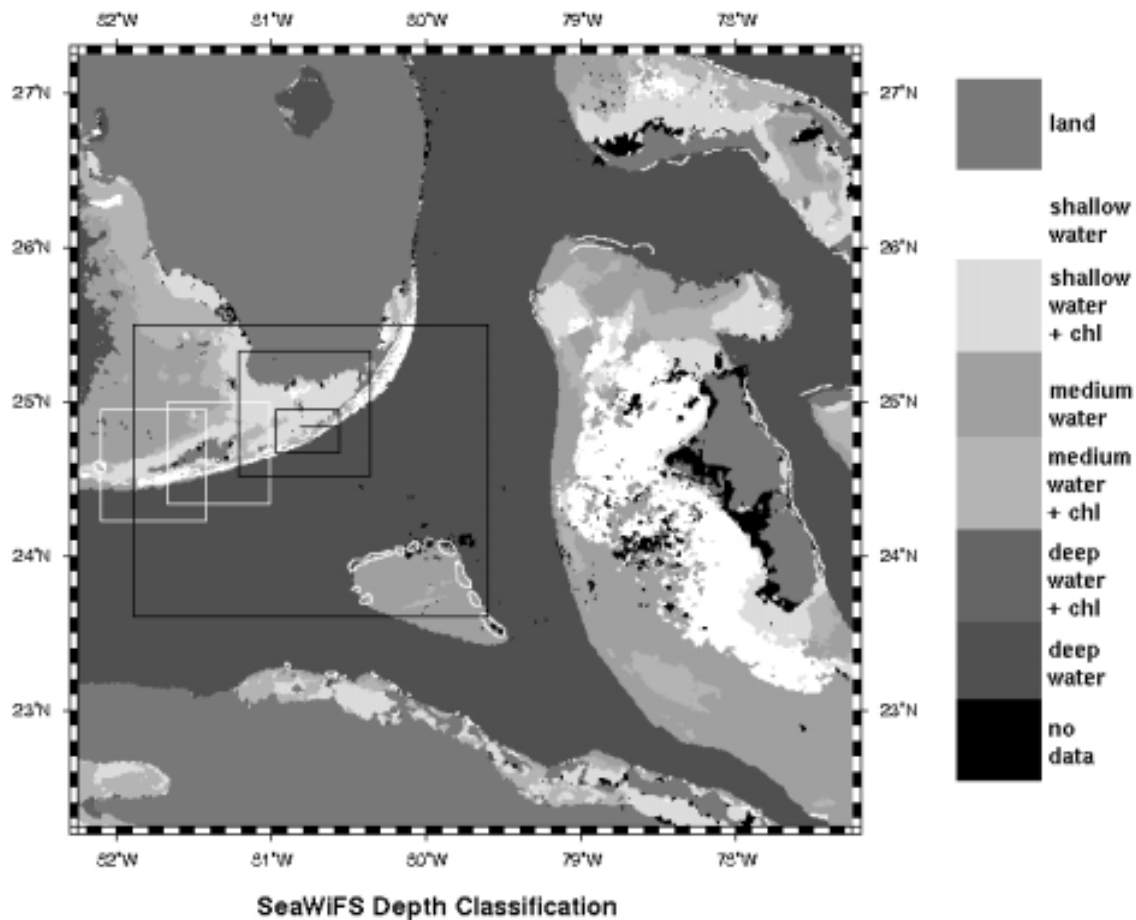
tography (an important contribution through the Johnson Space Center), Landsat imagery, MOS imagery, aircraft photographs and other sources becomes available, we will add it to our database with direct access at the Web Site (http://seawifs.gsfc.nasa.gov/seawifs.html!). The SeaWiFS database has many uses. It will provide a reference to a wide range of orbit-based imagery (such as Landsat). The database will be linked to the NOAA HotSpot studies in order to improve analysis where depth may be a factor in coral bleaching. For regions with poor chart information, SeaWiFS can help check the position of reefs (it has an accuracy of 1-2 km at nadir). Finally, it is the first step in establishing detailed information on bathymetry and bottom characteristics in coral reef environments on a national and global scale. A high resolution mapping and monitoring effort is now being developed for US waters (http://coralreef.gov).

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